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A BRIEF SKETCH OF THE TOOTHED WHALES (ODONTOCETI).

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AMONGST the larger denizens of the sea few are of greater interest either to the naturalist or to the ordinary observer than the Whales, or Cetaceans, as they are called; nor is this due alone to their size and strength, but to their peculiar habits, and in some cases to their intrinsic value. Moreover, in this group are the most gigantic types of living animals (for example, Sibbald's Rorqual, the Whalebone Whale, and the Spermaceti Whale), the former surpassing in bulk anything known in former epochs of the world's history.* The vast size of some is a feature of moment, since amongst mammals it often happens that the primæval forms exceeded in bulk those now living. Thus the gigantic Mammoth (*Elephas primigenius*) from the frozen soil of the alluvial plains of Siberia, and the giant Ground-Sloths (*Megatherium* and *Mylodon*) of the ancient tropical forests of South America much exceeded in size the living representatives of the respective groups. Unfortunately, also, the same may now be said of the Sirenians, since Steller's *Rhytina*—discovered at Behring's Island only in 1741—perished utterly in 1782, or in little more than forty years. This huge Sea-Cow, 25 ft. in length and weighing three or four tons, browsed on the tangles in the shallows along the seashore, and

* Though some Zeuglodonts reached 70 ft. in length.

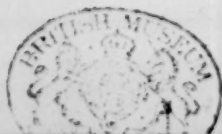
collected in herds like cattle. Mild and inoffensive in disposition, the *Rhytinæ* soon fell before eager crews, who ruthlessly slaughtered them for their savoury flesh. The smaller Dugongs and Manatees are the only Sirenians now living.

Besides mere bulk, however, the Cetaceans have enormous strength and activity, making their pursuit occasionally both difficult and dangerous. The comparatively large and much convoluted brain, even in the smaller Cetaceans, shows that intelligence is not less than is usually supposed; indeed those who have long come in contact with the living forms in our own seas can sufficiently vouch for this. Again, the large amount of oil obtained from the subcutaneous fat or "blubber," and the value of the whalebone of the Right Whale (a single long blade of which may bring from £12 to £14), all combine to render the group as valuable to the public as interesting to the scientific inquirer.

Some of the Cetaceans, just as the Zeuglodonts and their allies did in the Eocene, Miocene, and Pliocene, range over a very wide area—species which are indistinguishable from each other being found in the North Atlantic, as well as on the coast of New Zealand and the neighbouring Pacific. Others have a more restricted area, though in regard to distribution much yet remains to be done even on our own shores, as the recently established whaling stations show. Not a few species occur on the British shores in the living condition, while others have been beached either immediately after death or when the gases of decomposition have floated the carcasses shorewards. A few forms are confined solely to fresh water, *viz.* to the great rivers of Asia and South America.

The Cetaceans, or Whales,* in which term the small as well

* It is unnecessary in this brief outline to refer to the extensive literature of the subject, but the writings of our countrymen, John Hunter, Robert Knox, Sir R. Owen, Dr. Gray, Sir William Flower, Sir William Turner, Dr. Murie, Dr. Carte, Prof. Macalister, Prof. Cleland, Prof. D. J. Cunningham, Prof. Clark, Sir John Struthers, Mr. Lydekker, and Mr. Beddard merit special mention; whilst abroad the labours of the elder Prof. van Beneden, Prof. Sars, Professors Eschricht and Reinhardt, Prof. Lilljeborg, Prof. Collett, MM. Pouchet and Beauregard, Mr. True, Mr. Beale, Prof. Cope, Capt. Scammon, F. Cuvier, Prof. Gervais, M. Lacepède, and Prof. Nansen are equally important.



as the large forms are included as a group of mammals, are readily distinguished by their wholly aquatic existence, the only other mammals having a similar habit being the Sirenians, *viz.* the Manatees and Dugongs, which, however, diverge considerably in structure from the whales. So truly aquatic are the Cetaceans that deposition on land is usually fatal, and therefore they materially differ from such as the seals, which frequently leave the water of their own accord and bask on the rocks and sand. An exception, however, was the Californian Grey Whale (*Rhachionectes glaucus*), which was often found amidst the surf. This interesting species is said to be now exterminated by the persistent pursuit of man. While thus they resemble the fishes in being confined throughout their existence to the water, they are as characteristically mammalian in structure as the most typical member of that class, though it is true their framework as well as their various organs are modified to suit their aquatic life, and some parts are absent or rudimentary.

In the form of the body the Cetacean is fish-like, being spindle-shaped or club-shaped in outline, without a definite neck, though in one or two a trace exists, tapered more posteriorly than anteriorly, and having a powerful tail composed of two divisions or "flukes," placed horizontally, and thus differing from the vertical tail of all fishes and the gigantic Ichthyosaurians. The body is covered with the mammalian skin, the surface or cuticle being smooth, and with comparatively few hairs, so characteristic of other mammals. This scarcity of hairs might at first sight be considered a most exceptional feature, since one of the leading characters of mammals is the presence of such a covering. A closer scrutiny, however, shows that hairs are by no means absent in the whales. Thus, for instance, the newly born Right or Whalebone Whale has numerous bristles on the upper and lower lips* and near the blow-holes. Moreover, Mr. Lilliet has recently shown that in the adult examples of *Balænoptera musculus* and *B. sibbaldii* a definite distribution of hairs could be made out in the shape of four rows of straight, white, bristle-like hairs on

* Sixty-six near extremity of upper jaw; about fifty on each side of lower lip; a few near blow-holes.

† Proc. Zool. Soc. 1910, p. 773, with text-figs., May, 1910.

the dorsal surface of the snout, and on the outer edge of each ramus of the mandible from the tip to near the eye is another row of hairs. Most of the Toothed Whales, such as the Pilot-Whale, White-backed Dolphin, Porpoise, and Common Dolphin,* in their embryonic condition, show similar hairs, but *Delphinapterus* and *Monodon* do not. In some again a series of pits (forming a circlet) are also present in the upper jaw, passing through the coloured or pigmented region of the horny layer of the skin, but whether these represent hair-follicles is unknown. The late Sir William Flower, one of the most distinguished authorities on the whales in this country, as well as recent Continental observers, such as Kükenthal and others, consider that the presence of such hairs indicates that probably the ancestors of the modern whales were much more hirsute. Besides hairs, two species of porpoise, namely, the common form and *P. spinipinnis*, from the western shores of South America, present spines on the dorsal fin, the latter on the back as well as on the front of the fin; whilst *Neomeris*, a porpoise from the Southern Atlantic, Indian and Pacific Seas, has a series of dermal ossicles in several rows along the dorsum throughout the greater part of its length. So far as observed in young porpoises at St. Andrews, the spines or tubercles are much less developed than in the adult, so that this species does not fall in with the notion of "inheritance from a more completely armoured ancestor."† The figure of the dorsal fin of the Common Porpoise, as copied from Kükenthal, differs materially in its posterior outline from anything observed in Scotland.

In regard to the structure of the skin, a well-developed corium (true skin, *cutis vera*) is absent in most Cetaceans which have a thin horny layer, and the Malpighian layer is much developed and has long papillæ. The glands of the skin are generally absent, as are also the muscles, while the cutaneous nerves are sparingly developed. The smoothness of the surface of the whales is probably associated with their surroundings, since a mammal with a smooth skin seems to be better adapted for a purely aquatic life than a hairy one. The further structure of the skin will come under notice when dealing with the

* Prof. D. J. Cunningham.

† Beddard (after Kükenthal), *vide* 'A Book of Whales,' pl. ii. fig. 6.

Toothed Whales, so that the only general features that call for mention are the anterior limbs, which have the form of flattened paddles—called flippers—in which the bones of the arm and hand are covered with the dense integument without nails, the absence of hind limbs and external ears.

Whales may very naturally be divided into two great groups, viz. the Whalebone Whales and the Toothed Whales (*Delphinidæ*), whilst the Physeterine Whales (called after the *Spermaceti* Whale), and the Ziphoids, also Toothed Whales, have an intermediate position. These Toothed Whales are less specialized than the Whalebone Whales, for in the latter whalebone appears to be a peculiar development of the gum in animals which formerly had teeth. Thus in the very young or embryonic whale (*e. g.* a Finner), teeth appear and afterwards disappear in the jaw long before the whalebone grows, indicating that the toothed condition is the primary, the brush-like arrangement of whalebone the secondary, condition.

This group (Odontoceti), while presenting teeth in most instances (though in some there are none), as in other mammals, yet exhibits certain aberrant features: in the asymmetry of the skull,* the single external nostril, which is situated far back and with peculiar knob-like nasal bones, the absence or rudimentary condition of an organ of smell, the attachment of the periotic to the skull (the tympanic not being ankylosed to the periotic), the flattened plate of the maxillary, lachrymal inseparable, the complex stomach, absence of a cæcum (except in *Platanista*), the aberrant condition of the hand, which, however, is pentadactylous, the nearly straight condition of the halves of the mandible, the presence of true capitular processes on several of the anterior ribs for articulation with the bodies of the vertebræ, the division of the sternum into various pieces, and the attachment to it of several pairs of ribs by cartilaginous or ossified sternal ribs.

* Lillie has lately attempted to account for the asymmetry of the Odontocete skull by the position of the pipe-like continuation of the larynx, which, instead of being in the middle line as in the *Mystacocetes*, is placed close to the left wall of the pharynx (*Proc. Zool. Soc.*, May, 1910, p. 781, text-figs. 73 and 74). Yet there is no asymmetry in the hyoidean skeleton of any Odontocete.

In external form the Toothed Whales vary, from the massive club-shape of the Spermaceti Whale, the head of which resembles an enormous battering-ram, to the more elegant curves of the active Dolphins. Some (as the Killer) have, and others (as the White Whale and *Neomeris*) do not have, dorsal fins, and the flippers are either short and broad, as in the Spermaceti and Susu (*Platanista*), or elongated, as in the Pilot-Whale. They vary in external coloration, from the deep black of the Pilot-Whale to the yellowish white of the Beluga, and the bluish colour of *Orcella fluviatilis* of the Irrawaddy, some being variegated with black and white, as the Killer and several Dolphins, or speckled, as in the Narwhal. Moreover, in such as *Mesoplodon*, a pair of gular grooves are present.

In the structure of the skin they agree with the general type already mentioned, *viz.* in having an epidermis of variable thickness, the surface being formed of the corneous layer which usually shows flattened cells, while the Malpighian layer beneath presents polygonal nucleated cells with interstitial fibres, and contains the pigment. Chemically, the skin shows keratin, and in certain forms, as the White Whale, is manufactured into excellent leather, and there is no reason why the skins of others should not be similarly utilized, especially when it is remembered that the skin of the Spotted Wolf-fish is made into excellent leather in Norway. In connection with the layers just mentioned, it is an interesting fact that the young (yearling) White Whale is of a leaden or bluish black hue, from the greater development of pigment at the inner border of the Malpighian layer, but as it grows older it becomes mottled, and finally assumes the soft cream-like tint or yellowish white of the adult, and the nearly pure white of the old animals. This perhaps indicates that the white is an acquired character. The pigmented layer in the skin of the Cachalot is alkaline from free soda, a great convenience to the whaler by enabling him to cleanse the ship and his clothes from the oil with which the alkali readily combines.

Beneath the Malpighian layer of the skin is a thin membrane, *e.g.* in such as Beluga, which probably represents the true skin (corium). Then come the connective tissue and fat, varying from one to several inches, 4 to 8 to 14 in. in Cachalot,

and usually termed "blubber," the main cause of the relentless persecution which these animals suffer at the hands of man. This fatty tissue attains great depth—for instance, on the snout of the Pilot-Whale, and in the same region of the Cachalot, where the soft, yellow, and oily mass ("junk") based on the upper jaw weighs between two and three tons. Besides this, however, and resting on it, is a large area, to which the term "case" is applied by the whalers, abutting on the nasal canal, the whole of which is filled with an intricate web of cellular tissue, containing in the interstices a clear oily fluid (chiefly spermaceti). Twelve barrels, or about three hundred and seventy gallons, of this material have been collected from the "case" of a single example. The great accumulation of these relatively light substances in the huge head of this species is, in the opinion of some observers, a provision for rendering the region buoyant.*

The dorsal humps and dorsal fins seen in many of the whales of this group (*i. e.* the Toothed Whales) have a large quantity of the same fatty tissue or blubber. They are simple integumentary folds with tough connective tissue and fat, as in the hump of the camel (Dr. Murie). It is interesting that these fins begin to develop in the young only after the formation of the flukes, showing perhaps that they have been acquired more recently.

As might be anticipated in animals so powerful and so active as the Cetaceans, the muscular system, which lies beneath the former tissues, is highly developed. An examination of the plates in the elaborate paper of an old friend, Dr. Murie,† shows that several powerful sheets act on the flippers, while a still more remarkable series of muscles give great power to the flukes of the tail. The more complex arrangements of this system need not be dwelt on, but a glance at these anatomical figures shows that structure in this respect conforms to function, and that the swift propulsion of the huge body through the water, the balancing and sounding actions of the flippers, and the sculling and balancing movements of the tail, so admirably told by a late colleague, Prof. Pettigrew, and which in ordinary

* F. D. Bennett, surgeon, 'A Whaling Voyage round the Globe,' 1840.

† Trans. Zool. Soc. vol. viii. p. 238, pls. 36 and 37.

progression cause the water behind the Killer, for instance, to be violently churned as from the screw of a powerful steamer, are all provided for in the smallest possible compass.

The posterior extremity of the body of the Cetacean is furnished with the flukes, which consist of strong fibrous tissue covered with skin—in some forms, symmetrically fimbriated—and with which certain of the muscles just mentioned are connected. The “blubber” again becomes very thin as it approaches the root of the tail, and finally is lost in the fibrous substance of the organ. The strength of the muscles moving the tail enables the animal to strike the water with great power vertically and at any angle. The larger toothed forms—such as the *Sperm Whale*—crush strong whale-boats into fragments with a single blow, or occasionally send a harpooner through the air to a distance, and the *Californian Grey Whale* was equally dextrous with its tail. By its aid also these huge animals spring clear of the water with all the agility of a *Salmon*, a feature likewise very characteristic of the smaller forms, such as *Dolphins*, groups of which now and then leap from the slopes of the great waves in the *North Sea*, making a loud noise as they again strike the water.

Two prominent views are held with regard to the homologies of the caudal flukes. Thus *Owen*, *Flower*, *Huxley*, *Claus*, and *Parker* suppose that the whole hind limb has been suppressed or atrophied externally, and that the flukes, like the dorsal fin, have been secondarily acquired. *Ryder*, again, thinks that the flukes are probably degenerate homologues of hind feet; while *Gray* and even earlier authors held that they represent the whole hind limb. *Ryder* supports his view by pointing out that the skeletal elements of the posterior limb have been atrophied from without inward, and that only traces of the femur and pelvic arch remain in certain forms. Further, that the muscles of the tail are connected with the flukes, the blood-vessels of which are arranged in a dorsal and in a plantar set as in the foot; that there is a tendency in the nerves of the lumbar plexus to be prolonged toward the tail to supply caudal muscles; that the direction of the crus, when developed, is in the line of the flukes; and, lastly, that the flukes are developed as in other limbs. *Ryder* is supported by *Prof. Gill*, who also con-

siders that the flukes are developed from the greatly hypertrophied integuments of the hind limbs, analogous to such as are present, for instance, in the hind limbs of the eared Seals, while the osseous elements have been inversely atrophied, pulled forward and reduced to supports for muscles. With all respect for this ingenious theory, the view of the anatomists first mentioned seems most to accord with fact, as also are the views of Mr. Beddard, who points out that *Ichthyosaurus*, as shown by Prof. Ahlborn, had a heterocercal tail with the vertebræ along the lower border, and yet had hind limbs.

The anterior limbs form a pair of paddle-like organs or flippers (comparable in some respects with those of the *Ichthyosauria*), which consist of the shortened arm, fore-arm, and hand, enveloped in tough integument. These limbs are attached to a shoulder-girdle formed of a flattened scapula with a forward process, the coracoid, and above it the acronicon. In the Sperm-Whale the flippers are short, broad, and truncated, in the Ziphoids small and ovate, in the Susu broad and truncated,* and the same in certain Dolphins, such as the Narwhal and White Whale (*Delphinapterus*), longer in the Porpoise, large and ovate—nearly as broad as long—in the Killer, narrow and pointed in *Pseudorca*, very long and narrow in the Pilot-White, of moderate size, narrow, pointed, and somewhat flattened in the Dolphin. These organs are used in balancing, and it may be in certain instances in sounding, as in the Ca'ing Whale, and still more in *Megaptera*, one of the Whalebone Whales, an example of which the whalers endeavoured, after it was harpooned, to drive on the beach at Scotsraig, near the mouth of the Tay, but it sounded with its long white flippers, and turned to deep water.

As indicated in the remarks on the tail, no traces of posterior limbs appear externally, but a rudimentary pelvic bone (ischium, though Delage considers that it represents the ilium and pubes as well) exists on each side for the attachment of certain muscles, except in the Susu (*Platanista*), in which it is absent.

The skeleton of the Toothed Whales presents certain distinctions when compared with that of the Whalebone Whales,

* See an important memoir on the manus of this form by Sir William Turner (Proc. Roy. Soc. Edin. vol. xxx. p. 508, with text-figs., 1910).

the most conspicuous differences existing in the skull, which is asymmetrical in the toothed forms. Moreover, considerable differences exist between the various Odontoceti themselves—for instance, between the skull of *Hyperoodon*, with its great maxillary crests, and the flattened skulls of *Monodon* and *Delphinapterus*. In the Ziphoid Whales and *Platanista* (Susu) there are great maxillary crests. The skull in the Toothed Whales is often broad and depressed, but the snout may be much elongated, as in the Dolphins, the Ziphoids, and the Susu. The nasal bones occur as “nodules or flattened plates applied closely to the frontals” (Flower), and not taking any share in the roof of the nostril.* The lachrymal is either fused with the jugal, “or, when distinct, very large, and covering the greater part of the orbital plate of the frontal” (Flower). The tympanic bone is not fused with the periotic, which is only held in position by ligament. The parietals do not meet above, but the space is occupied by the large supra-occipital. The pterygoids are short, thin, involuted, and form with the palatine process the outer wall of the posterior palatine air-sinus. In Physeteroids these bones are only hollowed on the outer side. In *Ziphius* the premaxillaries are expanded at the sides of the nares, hollowed, and with elevated margins, while the right is more developed than the left. These bones in the Toothed Whales generally bear no teeth, and are characterized by their great length; moreover, they are ensheathed laterally by the maxillæ. In the Ziphoids also there are distinct malar bones, and the pterygoids are large and meet in the middle line. The meso-ethmoid is densely ossified, and in *Mesoplodon* it coalesces with the others.† The premaxillaries are convex in front of the nares in the White Whale (*Delphinapterus*). The halves of the mandible are almost straight, deep posteriorly, and they form a true symphysis anteriorly. The symphysis is generally short, except

* Short nasals occur in the Saiga, and the spiracular sinuses of this form and the Tapir are, according to Dr. Murie, homologous with those of the Cetaceans (Trans. Zool. Soc. vol. viii. p. 242, &c., text-fig.).

† Principal Sir William Turner's able account of the skeleton of this form may specially be referred to. He observes that “the meso-ethmoid septum was prolonged into the upper end of the medio-rostral gutter for 8 cm., and was embraced anteriorly by the medio- (meso-) rostral bone” (Proc. Roy. Soc. Edin. vol. xxix. p. 687, with text-figs., 1909).

in the Sperm-Whale, and in *Mesoplodon* the halves of the mandible may not be fused at all.

The cervical vertebræ are free in the Susu, White Whale, and in *Monodon* also, or with irregular unions, the atlas and axis being free; in *Physeter* the atlas alone is free, in *Ziphius* the three anterior vertebræ are united, the rest are free; in the Porpoise the first to the sixth have coalesced, and sometimes the seventh joins them. In *Orca* the bodies of the first and second and sometimes the third are united; while in *Globiocephalus* the anterior five or six are united. In *Pseudorca* the first to sixth or seventh are united, and the bodies of the lumbar vertebræ are more elongated than in *Orca*.

One of the most interesting features in connection with the whales is their method of respiration, and it has been more or less carefully investigated in the group now under consideration. Air-breathing animals entirely confined to the water, where they find their food and, moreover, have in its depths freedom from pursuit, must of necessity present special modifications of the typical mammalian organs. Externally, the Toothed Whales have a single blow-hole or nostril, which is generally transverse and crescentic, with the horns of the crescent pointing forward, though in the Susu it is longitudinal, linear, and median, and in the Sperm-Whale longitudinal, *f*-shaped, and to the left of the median line. The blow-hole closes by its own elasticity, but opens by muscles. Except in the Sperm-Whale the aperture is on the top of the head, far removed from the usual position in mammals. The air is conveyed by the nasal passages, which have sinuses or spaces, to the laryngeal apparatus, the distal portion of which (arytenoid cartilages and epiglottis) is remarkably elongated—forming, indeed, a tube with an enlarged end—which is grasped by the muscles of the soft palate, very much as in the young marsupial in the pouch. Thus, when the blow-hole is closed and the larynx grasped, the whales can swallow their food without the danger of admitting water into the windpipe. They rise to the surface for air, projecting the blow-hole and blowing—that is, expiring the air from the lungs and rapidly drawing in fresh air. The condensation of the warm moist air from the lungs forms a column of vapour, which shoots to a greater or less height in the air. In the case

of the larger whales this expired air is sometimes so impure as to have a fœtid odour, and blackens lead paint. The lungs are capacious so as to enable the animals to sustain immersion for a considerable time, but the ribs are less free than in the Right Whale. A comparison of the thoracic chambers of the Whale-bone Whales with those of the Toothed Whales certainly gives the impression of greater powers of expansion in the former, the skeleton of the thorax in the Toothed Whales approaching more nearly that of the Seals. Yet a large Sperm-Whale remains about an hour below water, sometimes even longer. When it comes to the surface, it sends off obliquely upward and forward a succession of spouts at intervals of ten or fifteen seconds, the expirations, according to Bennett,* making a rushing noise like surf-waves, but no sound connected with inspiration is heard. The smaller Toothed Whales would appear to remain a much shorter time under water, and such as the Ca'ing Whales in respiring make a considerable noise, somewhat like the sudden escape of steam from a valve, or still more like the puff of a gas- or oil-engine. Yet it sometimes happens that a large Finner will thrust its head above water, as at the entrance to Loch-maddy, within a few feet of a boat, perhaps for observation, and no sound be heard or vapour seen. The boatman, in alarm, in this case, shouted that his frail craft would be swamped by the tail as the Whale went under, but, as it happened, the Finner, after inspecting the boat for some seconds, quietly slid below the surface, and, being suspicious, had turned its head seaward and passed out of the loch into the Minch. As on this occasion the sea was as smooth as glass, the blowing of a Whale in the loch would have been seen for miles; indeed, the heads of the Seals were everywhere conspicuous. Seeing that such forms must come to the surface to breathe, the mode in which they respire during sleep, and, indeed, the position during the latter condition, are at present obscure. Some whalers are of opinion that the Right Whale sleeps head downward for hours in the water, or at least below the surface, while its tail is at the surface,† and that one has been harpooned in this position. A recent writer, indeed, supports this view by the case of a

* 'Narrative of a Whaling Voyage, 1840.'

† D. Gray, 'Scottish Fishery Board's Report, 1889.'

Narwhal which he found quiescent, and apparently asleep at the surface with its head immersed, and is of opinion that in Whales respiration is suspended during sleep. As stated, however, in 1885, when the matter was first brought forward at the Aberdeen Meeting of the British Association (where Mr. Gray read his paper), further observations are necessary. Collett* and Lilliet† both refer to the views of whalers, who think that after storing their lungs with air the Finners can remain eight or ten hours under water.

The organs of the circulatory system are so similar in most respects to those in ordinary mammals that they need not be alluded to, save on one point, *viz.* the presence of numerous spongy networks of blood-vessels (*retia mirabilia*), such as those in the region of the spine, which by some are supposed to be connected with respiration, but which may also serve for the interchange of material between the lymph and blood, and therefore connected with nutrition; or the network may supply pure blood to the spinal cord and brain during immersion, and when great pressure on the lungs exists.

As parts of the digestive system (the next subject for consideration), the teeth form a characteristic feature. They are of the kind called "homodont"—that is, nearly alike, the only exception being the Zeuglodonts (of which the skull and vertebræ only are known) of the Eocene period of North America.‡ The Zeuglodonts, however, differ considerably from the living Toothed Whales—in fact, they hold an intermediate position between the Toothed and the Whalebone Whales. The teeth anteriorly are simple and conical—the first three in the premaxillary, and therefore corresponding with incisors, the next is also simple and conical, but it does not exceed the others in size. Then follow five teeth with two roots, and compressed, pointed, denticulated crowns. The teeth in the Dolphins are held by Kükenthal and others to belong to the milk-dentition, and therefore that they are truly diphyodont, like most terrestrial mammals.

* Proc. Zool. Soc. 1886, p. 263.

† *Ibid.*, 1910, p. 790.

‡ Giebel, Jourdan, and D'Arcy Thompson think Zeuglodonts are allied to Seals and Carnivores, not to Cetaceans.

In the Sperm-Whale the massive teeth, which some (with a tinge of romance) say the animal uses as lures for the cuttle-fishes on which it feeds, have no enamel, only dentine covered with cement, and they form good ivory. In the allied *Ziphius*, again, only one tooth occurs on each side near the anterior end of the mandible. In *Mesoplodon* these form strong tusks (one on each side), larger in the male than in the female—indeed, it has more than once happened that this form has been described as edentulous, since they are sometimes hidden in the gum, or may have been lost. In the Bottle-nose (*Hyperoodon*) they are minute and entirely concealed in the gum, so that the animal is practically toothless.* In the Susu they are numerous, sharp in the young, worn in the old. Amongst the Dolphins the teeth, as a rule, are more or less numerous in both jaws. In the Narwhal, however, besides some irregular rudiments, only a pair occur in the upper jaw-bones (maxillaries). These are concealed in the female, but in the male the left tusk is more than half the length of the animal, with a sinistral spire.† The teeth of the Killer are powerful organs for prehension—sharp in the young, blunt and sometimes angled from friction in the old animals. The crowns are coated with enamel.

The stomach in the Toothed Whales is complex, some authors attributing no fewer than six or seven chambers to that of the Bottle-nose. Others, again, are of opinion that only two compartments exist in the stomach of the Pilot-Whale, but, as Dr. Murie, in his able memoir, states, there are at least four. The first cavity in this species (Pilot-Whale) is the largest—and this in the Porpoise is characterized by its pale, tough, non-vascular lobulated folds; the second a globular sac, with highly vascular ridges in the Porpoise; the third also rounded; while the fourth is an elongated cavity with the pylorus at the end of it. There is thus a certain resemblance to the condition in the Sirenians and in the ruminant ungulates, such as the ox and sheep.

It is an interesting fact that these huge inhabitants of the

* As in the examples in many museums.

† Some suppose it pierces the ice with its tusk to breathe; others that it uses it as a spear for fishes. Occasionally two tusks of nearly equal length are present.

ocean prey to a large extent on cuttle-fishes. Thus the Sperm-Whale feeds on these for the most part, though it also swallows fishes, such as the cod, albicore, and bonito. It has been supposed that this whale descends in the water and opens its mouth widely, so as to expose the teeth as a lure, as already indicated, but the great numbers and often large size of the cuttle-fishes in the regions frequented by the Sperm-Whale make capture by the ordinary method probable, and Lillie has supposed that certain marks and abrasions on the skin of the head of this whale are due to the suckers of gigantic cuttle-fishes. That teeth are not absolutely necessary for the capture of the squids and other cuttle-fishes, the case of the Bottle-noses (*Hyperoodon*) sufficiently proves, since they are practically toothless; yet to a large extent they live on these creatures (e. g. *Gonatus fabricii*). Holothurians are also found in their stomachs.* The Narwhal feeds on similar forms, besides small fishes and crabs. The Susu of India, again, preys on fishes, such as *Wallago*, *Saccobranchus*, and species of *Clupea*, and Dr. John Anderson, who has written an important memoir on this form, finds that it pursues the fishes into the paddy-fields, and thus grains of rice may readily get into its stomach. The Porpoise, White Whale, and the Dolphins, again, live mainly on fishes, the destruction of food-fishes by the Porpoises alone on our shores being noteworthy; and, as digestion goes on rapidly, the lenses of the eyes and the otoliths are soon the only recognizable parts in the first stomach. No provision, indeed, exists for the passage of other than semi-fluid material into the gut, for the pyloric opening is minute. The most predatory of the whole series, however, is the Killer (*Orca*), the only one which feeds on animals with warm blood, though it varies its diet by occasionally devouring fishes. This powerful Whale swiftly pursues Porpoises and Dolphins, seizes them with its powerful teeth, and swallows them entire. The same fate befalls the nimble Seals, the skins of which, turned inside out, it ejects by-and-by from its stomach, after the manner of birds of prey with balls of hair, or like the

* It is curious that the Teleostean "dolphin" (*Coryphæna*) also feeds on cuttle-fishes. This may be of interest to those, like Dr. Jungklaus, who think that the absence of the first stomach in the Ziphoids is associated with their diet of cuttle-fishes.

Chimpanzee, with the feathers of the birds it eats. The Killers, indeed, are the terror of their neighbours in the ocean, for a few of them will drive a herd of White Whales shorewards in terror, and they even beach themselves in their efforts to escape these predaceous animals, which bite large portions from their fleeing prey, so that the surface of the water is covered with oil and blubber, for, like other carnivorous forms, they kill and lacerate more than they can possibly eat. The fondness of *Orca* for the White Whale seems to be the explanation of the pursuit of a white-painted boat off the Outer Hebrides by a large example. The fishermen on board had great difficulty in beating it off with oars and a boat-hook, and as quickly as possible gained the shore. The larger Whales, such as the Blue Whale (Sibbald's Rorqual) and the Hump-backed Whale (*Megaptera*), are also attacked by the Killers, and severely lacerated or killed. The great voracity of these animals is well shown in the careful description of a specimen, 21 ft. long, by Prof. Eschricht, who found that the first stomach was about 6 ft. long and 4 ft. broad. On opening it he at once discovered five or six Seals, some large, others small, all flayed, and so closely intertwined that it was necessary to pull them out one by one to count them. But this was not all; gradually Porpoises were disclosed, one entire, the rest more or less digested, or represented only by bones. The examination by this competent anatomist showed that when the contents were carefully assorted no fewer than fourteen Seals and thirteen Porpoises had recently been devoured. The Killers frequently attacked the young Californian Grey Whales, and have been known to pull down a captured Whale when boats were towing it to the ship.

The sense of sight in most of the Toothed Whales is tolerably acute, and, indeed, the eye of such as the Killer is larger in proportion than that of the Whalebone Whale. Many of the larger forms have a habit of thrusting their heads above water to reconnoitre when they suspect danger, as, for instance, the Pilot-Whales when they have been embayed, or the Sperm-Whale when hunted. Though the auditory canal is small and there is no external ear, the sense of hearing is fairly developed. The organs of smell are, on the other hand, in a rudimentary condition or apparently absent, and in this respect they are inferior

to the Whalebone Whales. Taste would not appear to be highly developed, and the tongue is more or less fixed to the floor of the mouth. Many of the Toothed Whales are extremely sensitive to their surroundings, and some observers have supposed that, for instance, the Sperm-Whales are enabled to communicate with their fellows at long distances, or at least that the latter, especially the females, become aware of danger to their fellows, and endeavour to succour them.

The general acuteness and the social instincts of the Toothed Whales are highly developed. The dexterity of a pair of Ca'ing Whales in surveying a series of salmon-stake nets is noteworthy. Their strong social instincts often lead to their destruction, the whole "school" or herd keeping together and being driven by encircling boats on shore. It would be difficult to find a better illustration than that which occurred in Scalloway Harbour (Shetland) a season or two before 1871. More than two hundred of these Whales had been driven by a chain of boats into the harbour of Scalloway, which formed a fatal *cul-de-sac*, communicating with the outer sea only by a narrow inlet. The slaughter of the unfortunate animals was at its height in the confined area, in which the Whales were so packed that boats and men were upset in the deeply dyed water, when a large old male, approaching 30 ft. in length, broke through the boats on guard, passed along the narrow inlet, and, in spite of opposition, reached the open sea. There he swam about a short time, but, finding himself alone, he once more headed for the inlet, passed the boats, and was killed in the centre of the others in Scalloway Harbour. The men justly regarded him as the leader of the herd.*

In connection with the reproduction of the Cetaceans, a feature of moment in the structure of the adult male Porpoise is the great size of the testes, which in July occupy a large share of the abdominal cavity, and at first sight are apparently out of proportion to the needs of the animal, which is often seen in pairs all round the coasts of Britain. It is true, at a glance, in Shetland one hundred and fifty or more may be observed during the same month, disporting themselves (pro-

* The skulls of the Ca'ing Whales are generally used as props for boats at Scalloway, a purpose for which their shape peculiarly fits them.

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bably feeding) along the margin of a voe or bay, the black specks at a distance resembling a swarm of ducks. The penis is large in most Cetaceans, and especially in the Porpoise, in which the tip is slender, almost probe-pointed, with the aperture of the urethra just within the extremity. The size of the testes, which greatly exceed in proportion those of the polygamous ram, would point to similar habits in the case of the Porpoise, yet there is no clear evidence on this head.

Further, at St. Andrews, in July, single Porpoises have often been noticed swimming quietly in a circle near the commencement of the East Rocks, and they have been found to be adult females accompanied by their young, which may be observed, as the mother rolls on its side, snapping at the mammæ. Moreover, it has happened that the suckling has been captured in a salmon stake-net, or stranded on the beach, whilst on one occasion an adult female was caught in a neighbouring stake-net with the milk flowing from the teats* on slight pressure, as when laid on a slab. Like certain other forms, the Porpoise therefore seeks the shore for reproduction. Such may also have been the reason why a Ca'ing Whale of 12-14 ft. sought the beach at the laboratory in October some years ago, and was almost stranded, until, by a desperate effort, it reached deeper water, and in its fright headed for the open sea with all speed.

Like the Whalebone Whales, the toothed forms are for the most part captured by the harpoon, the harpoon-gun of modern times being so efficient a weapon as sometimes to kill the smaller forms by a single discharge. The modern harpoon is fired from a gun fixed to the bow of the whaling-boat, and has a screwed point containing an explosive, which is fired by a seconds fuse. While dealing destruction, for instance, in the thorax behind the flipper it does not disengage the flukes of the harpoon from the tissues, so that the "line" (rope) from the boat still holds. Whether the Toothed Whales can be profitably caught by the Japanese method of throwing a large rope-net over them and towing them to shore alive remains to be seen. The large Whalebone Whales are thus captured. The most

* *Vide* "Chemical Composition of the Milk of the Porpoise," by Prof. Purdie, F.R.S., 'Ann. Nat. Hist.' December, 1885, and 'Chemical News,' October 2nd, 1885.

valuable species is the Sperm-Whale, the fishing for which was begun by the British in 1775, and ceased when it became no longer remunerative in 1853. The fishery was instituted much earlier by the Americans, who still carry it on. The pursuit of the Sperm-Whale differs in some respects from that of the Greenland or Right Whale, since it occasionally charges the boats, striking the men out of them with its tail, or rolling over on its back so as to bring its lower jaw more readily into action, it bites the boats. Even the ships themselves, it is said, have been attacked and sunk. A good whale yields ten tons of oil (= sixty barrels), besides spermaceti. Moreover, the intestine frequently contains a valuable concretion called ambergris—a bezoar. This species ranges over most seas, the fishery being chiefly conducted in the warmer parts of the Atlantic and Pacific. They go about in “schools” of males, females, and young, though old males are frequently solitary. It is occasionally stranded on our shores, and is captured with other forms at the British whaling stations.

The Bottle-nose (*Hyperoodon rostratus*) abounds in the Polar regions, and is supposed to come southwards in autumn and winter. It is hunted near the ice-edge from the coast of Labrador to Nova Zembla, chiefly in May, June, and July. It is not very long, however, since attention has been directed to it; the first clue was given by a ship from Peterhead in 1877, for, failing to catch Seals, it turned its attention to the Bottle-noses. They have been specially hunted since 1882, in which year two hundred and three were captured by the late Capt. David Gray, of Peterhead. The Norwegians still pursue them, but the British whalers have not found them remunerative. An average specimen yields 22 cwt. of oil, five per cent. of which is spermaceti.

Of the fresh-water forms, the remarkable *Platanista*, or Susu, is confined to the Brahmaputra, Indus, and Ganges, as far up the rivers as the water will float it. It is caught by a bamboo shaft with an iron barb loosely let into the end, and to which is attached a long line wound round the bamboo. It is eaten by many of the low caste Hindoos, the Sansee women being particularly fond of it. Its oil is used as an embrocation for rheumatism, for burning in lamps, and for coating leather.

The White Whale is captured for its blubber, chiefly in the Arctic Seas, though it sometimes travels southwards, and several have been stranded or captured on our shores. One passed the Gatty Marine Laboratory on a Sunday a year or two ago, and was probably that caught shortly afterwards at Cullercoats, and described by Prof. Meek. The whalers occasionally drive them into shallow water, especially when they see Killers after them, and kill them with lances, or into narrow bays, when their escape is prevented by strong nets. One ship in 1883 secured twelve hundred.

Besides the interest directly connected with the commercial value of the Toothed Whales, the natives along the banks of the Irrawaddy believe that a bluish fresh-water Dolphin (*Orcella fluviatilis*), described by Dr. John Anderson, purposely draws fishes into their nets, and each fishing village has its particular guardian Dolphin, which receives a special name. Moreover, suits are not infrequently brought into the native courts to recover a share in the capture of fishes in which a plaintiff's Dolphin has been held to have filled the nets of a rival fisherman. It need hardly be said that this superstition makes it difficult to obtain specimens.

A few remarks may be added about the homologies and the probable origin of the peculiar mammals just considered. Unfortunately Palæontology gives comparatively little help in the solution of these problems, though, as Sir William Flower suggests, it is possible that their absence from the Cretaceous seas may be accounted for by the supposition that the group was originally a fresh-water one, like *Platanista* of the Ganges, and the *Inia* of the Amazon, both of which retain certain generalized characters.

From the complex stomach of the Toothed Whales, the simple condition of the liver, and the structure of the respiratory organs, the great anatomist, John Hunter, was of opinion that they approached the Ungulates, or hoofed animals, the primary form of which was probably omnivorous, like the pig. Others, again, think that they have been derived from the carnivorous animals through the Seals and Walruses. Prof. Huxley sees in the teeth of *Zeuglodon* the connecting-link between the Cetaceans

and the latter group (*viz.* the Seals and Walruses). Prof. Ryder, of the University of Pennsylvania, agrees with him, and, further, believes that the terminal parts of the posterior limbs are represented externally by the flukes. Prof. Albrecht links them with his hypothetical Promammalia. Sir William Flower, again, who thinks the Whales were derived from terrestrial mammals with four limbs, with a hairy covering, with sense-organs—especially smell—adapted for living on land, strongly objects to the views just mentioned, since the Seal has been adapted for its aquatic life by the peculiar development of its hind limbs, while the tail is rudimentary. The greatly developed hind feet functionally represent the tail of the Cetaceans in which the hind limbs are absent. He thinks it difficult to suppose that when the hind limbs had once been so well adapted for swimming they could ever have been reduced and their action transferred to the tail. The animal must have been in too helpless a condition to maintain its existence during the transference. He considers it more reasonable to suppose that the Whales were derived from animals with large tails, which were used in swimming, and eventually with such effect that the hind limbs became no longer necessary. He instances such tails, for example, as in the American Sea-Otter (*Pteroneura sandbachii*), or the Beaver.

These theories, however, leave the inquirer very much where they found him, and there is still a want of anything approaching a complete ancestry of the remarkable animals which have formed the subject of these remarks. The absence of such explanations, however, detracts little from the interest associated with the striking modifications of mammalian structure, the social and other instincts, the economic value, and the peculiar habits which make them traverse the seas from the icy Polar regions to temperate latitudes on the one hand, and on the other pass up fresh-water rivers for more than a thousand miles. Their whole organization marvellously adapts them for their special existence, and it can only be a cause for regret that their persevering pursuit by man, aided by every modern invention, is in many cases rapidly thinning the ranks of animals so full of scientific as well as general interest.

Finally, few, even among zoologists, have devoted attention

to the relations which the Cetaceans—large and small—have to the marine fishes. Most of the Toothed Whales devour fishes or cuttle-fishes; certainly those of our coasts are chiefly piscivorous or carnivorous. The effect of removing from two to five hundred of these large fish-destroyers in a single season must, from the standpoint of those who believe in the impoverishment of the sea, give the food-fishes a better chance of survival. Yet no change has ever been noticed in regard to increase or diminution. The swarms of Herrings and white fishes and the abundance of Salmon remain as before. The same reflections arise in considering the recent captures, at the various stations in the British area, of the great Finners and Humpbacks (Whalebone Whales) in hundreds. Whilst some of these live largely on crustaceans, such as the *Euphausiacea*, or "Krill" (those on our coasts taking *Meganyctiphanes norvegica*), others frequently devour Herrings and other fishes in quantities, the annual aggregate being enormous. It has not been shown that the removal of these has in any way modified the abundance or scarcity of the sea-fishes, though their capture is unpopular with the fishermen, perhaps on the ground of doing them service by driving the shoals of Herrings nearer the coast. The destruction of the food-fishes by the two groups (Toothed and Whalebone Whales) probably equals that accomplished by man with all his modern apparatus. Yet the wholesale removal of such numbers of both kinds of fish-destroyers makes no change in the fish-supply. The resources of Nature are of so gigantic a kind as to be practically unaffected. It is no refutation of this view to point to the fact that in every civilized country the food-fishes near the shore are fewer or more difficult to capture than before, and this in countries where no trawling has occurred. Every food-fish when molested becomes more wary, and, though the larger forms are fewer in a given area which has been much fished, yet there is no scarcity of fishes. Just as the resources of the sea are not materially affected by the presence or absence of the great fish-destroyers, so the persistent and widespread efforts of man do not impoverish the sea to a serious extent. The negative results of the present costly International Fisheries' work and the now ominous silence on the head of the impoverishment of the sea (the mainspring of the undertaking)

speak for themselves, and corroborate the opinions expressed eight years ago as to the International Scheme* :— "The Government having elected to test, for instance, whether the views stated in the 'Resources of the Sea' hold, or if the opinions of the vast majority of the fishing population and others are more worthy of confidence, *viz.* that great deterioration [in the sea] has been caused by man, and that man can by various measures control that deterioration, it may after all be best patiently to wait for the result. Though the experience may be costly, it may likewise be salutary. Yet there is no fear of extinction of any species, especially of those important to man." Before and since that was written hatcheries for sea-fishes have striven for the cure of this "impoverishment," yet they have not convinced many experienced observers of their necessity, and have not yet given undoubted proof of their benefits, though there is no objection to affording a longer period of probation if that were demanded. A few "schools" of Porpoises or of the larger Whales would rapidly dispose of the comparatively small (though costly) additions on this head without affecting the general supply. Again, the ovarian contents of a few fishmongers' shops in March would far outnumber the total of the larvæ placed in the sea by the laborious efforts of all the hatcheries, yet the balance is unaltered. The scale of Nature's work in the ocean is beyond the action of such pigmy measures, and the study of the relation of the fish-eating Whales to the fisheries shows how completely beyond man's power it is to affect the survival of the ordinary food-fishes in the sea.

* 'British Fisheries' Investigations and the International Scheme,' Dundee; April, 1903, p. 33.

AN OBSERVATIONAL DIARY ON THE DOMESTIC
HABITS OF THE SPARROW-HAWK (*ACCIPITER*
NISUS).

BY EDMUND SELOUS.

(Continued from p. 68.)

BACK again at 4.40 p.m. and find the female Sparrow-Hawk covering the young as usual. She now sits so high that I can see her almost to the ventral surface. Just upon 5 she stands up in the nest, and, the next moment, flies off it, whilst almost as she does so I hear the cry of the male, and then see him obscurely amidst the branches. The female hawk makes one long graceful curve down upon him, then sweeps away, and, the next moment the male has flown out and dropped on to a branch well in my view—I get the glasses on to him and can see that there is nothing in his claws. The female has settled somewhat beyond him, and I cannot see her. Just upon 5.5, however, she flies to the nest, and as she comes down upon the rim (usual place) what looks like a small bird makes, if I am not mistaken (but in this I well may be), some movement as though to escape. In any case it is instantly eviscerated, as I gather, and distributed to the chicks, who are now seen leaping up in the nest, and seizing each mouthful ravenously. There is no pluming, red meat being instantly torn from the body, nor had I noticed any appearance of this having been plucked before. This last, however, does not go for much, since the distance and partial or complete interposition of the structure of the nest itself makes certainty here almost impossible—at any rate, something which I have not yet attained unto. From her leaving the nest to her coming down upon it again the hawk was away a bare five minutes. As far as I can interpret the matter, she must have flown direct to the male and received the prey from him almost, if not quite, in passing. Then settling, she probably made a hasty meal herself, before flying on with it to the nest. I hope, therefore, that I was mistaken (as is indeed probable) in my

suspicion that the bird moved of its own motion, after being thus brought in. The mind strives unconsciously to minimise and render inconsiderable the suffering that exists in Nature; but this is a mere weak—nay, a cowardly—concession to benevolent feelings. The feeding takes just five minutes, and the hawk almost immediately upon its close passes to the other side of the nest, and after standing there for a minute or two, covers the nest.

I now go to one corner of the plantation near to where the rendezvous between the male and female hawk usually takes place, in hopes of seeing the actual delivery of the booty on the next occasion, but the concealing properties of the foliage (more apparent to the field than to the theoretical naturalist) make this, I fear, a rather forlorn hope. I am, however, luckier than I expected, for just as I finish the above sentence (about 5.55), there is the cry of the male just above me. It is repeated, and the bird then flies amongst the beeches and settles in my sight. Almost as he does so the female comes flying up to him, and though the movements are so light and rapid that I cannot actually see the booty passed to and received by her, yet it evidently is so, for after settling for a moment quite near the male, with that curious plaintive cry which I have noted before, she flies to another branch, in splendid view, and I see that she has something in one of her claws only. It is not a whole bird, but no more than the fragment of one; it looks like the breastbone torn off from the rest, and, through the glasses, I see her now, for the first time, denude this of the feathers still clothing it, for it has certainly, I think, been partially plumed already. Then she flies with this to another tree, where I can still see her continuing the process, but, the next moment, goes straight to the nest with it—for though I cannot actually see the nest from here, I can locate it exactly. The male, therefore, not only brings in and delivers the quarry, but he delivers it, sometimes at any rate, both plucked (more or less) and in fragments, and this accords with the appearance of the object which I saw him carrying some time ago in the free air, outside the plantation, as noted. That, too, in its disc-like appearance, was suggestive either of the naked back or breast of some small bird torn both from the head and the rest of the body.

At 6.25 there is exactly the same scene over again—as far at least as I can follow it. The male flies in to the same or nearly the same place, the female comes flying up to him, seems just to pass him merely, then settles and utters the plaintive-sounding but in reality satisfied note—for whereas I had thought this a demand or petition for the morsel, it seems in reality to be the note of contentment, after having received it. In what follows, however, I am less lucky, not being able to see the hawk pluming or otherwise manipulating what she has got; but I see her, shortly, fly back towards the nest and disappear amidst the branches in which it is situated. Soon afterwards the male leaves his perch, and settles somewhere near. An interesting point to note is that, each time, the male has flown in to one point in a corner of the plantation—perhaps into the same tree, and this is either the actual one or the one next to it, in which, low down, is the deserted Jay's nest, where a dead bird—a young but fully-feathered Redstart—was placed by one of the hawks, and taken by the female on the following morning.

June 30th.—To-day, I only got to the plantation at 11.15 a.m., and disturbed the female hawk (I think) sitting on one of the trees near where I was going to take up my position. I walked to look at the nest—finding it empty—and then sat down where I had yesterday, wishing to make the same observations. In ten minutes or a quarter of an hour, there was a rushing in the air and the female hawk came sweeping through the trees towards the male, whom I caught sight of almost at the same time. It was the same as yesterday, except that the female seemed more fiercely insistent, her cry more importunate, even aggressive—indeed, it was very much like the swoop of a Lesser Skua after Gull or Tern, to force them to disgorge their fish. As before I found it impossible to see the actual delivery, and afterwards, though I got two or three views of the female hawk, I could never make out whether she carried anything, so that, getting impatient, I stalked her, as she flew from tree to tree, and, at last, out of the plantation, without being any the wiser. I then went to my usual observatory for the nest, and, in a few minutes time, she flew in, tore up something and distributed it to the young. My reading of the whole thing is as follows:—The female hawk had become impatient for supplies and left the

nest, not to hunt for them herself, but to wait about, in this tree or that, for the male. When the latter arrived she was more than usually eager, and seized the booty from him almost fiercely. Some of it she then perhaps ate, and would have flown sooner to the nest with the rest, had I not followed her about, to escape which annoyance she flew away, but shortly returned with it as related.

I now left and on returning, at about 4.30 p.m., found the hawk feeding her young. I saw her very plainly satisfy two, not in several alternate distributions but by cramming first one and then the other with a number of bits, the meal ending with the second cramming. I then went to watch at the corner of the plantation where the male usually comes in. After half an hour or so there was his cry and, in another moment, he sailed in, and hung suspended, on spread wings just under the roof of the beeches (all quite young trees and, by consequence, not very high), presenting a most graceful and elegant appearance. His legs were stretched downwards, and in both the clawed feet he held something which was clearly a portion and not the whole body of the prey. It was, I think, as before, the breast or breastal portion of a small bird, but there was not time to consider it or to put up the glasses. The male had not hung thus for more than a second or two, when the female hawk, coming straight from the nest, accosted him in the air, yet without appearing to touch him, and as he flew out from her what he had been carrying had disappeared. So, too, the next moment, had both the birds, and so quick and *mouvementé* was it that I could not tell which was which, as they vanished amidst the foliage, in opposite directions. Not being able to do any better I sat down to watch the nest, and at 5.25, the female hawk flew on to it with her acquisition with which she, at once, fed the chicks. This lasted six minutes, and she then stood statuesquely, for some time, after her wonted manner. She had been absent from the nest, since leaving it to join the male, about five minutes, during which time she had probably been occupied in eating a part of what she had received or in plucking or completing the plucking of it, as I have previously seen her do. About 6 the male hawk again entered the plantation, but the female did not leave the nest nearly so soon, and when she did I

was unsuccessful in seeing anything except that the two were together. She stayed longer away this time, and, on her return, stood for a little while on the nest's edge without making any distribution. After that she did feed the chicks, but not in so interested a manner as usual, nor were they, on their parts, nearly so eager; also it was soon over, all which facts are explained by the interval between this and the last meal not having been a long one, so that neither mother nor children were hungry. Leave at 6.35 p.m.

In this distribution, as well as the last one, and one or two preceding it, it is to be noted that the hawk has stood upon the opposite side of the rim of the nest to that on which, from the beginning, it has been her custom to, and in afterwards covering the chicks has stepped over them in the opposite direction, and settled herself from that side. This a curious reversal, for it is not at all as if the bird stood now on one part of the nest, and now another, indifferently. On the contrary, there has been uniformity for a long time, and now, when a change comes, it is the exact converse of what was, whilst the uniformity continues.

July 1st.—Got to the plantation before 3.30 a.m. and waited in a part of it that the male hawk usually comes to. At a few minutes past 4 I heard his cry, and a little afterwards there was the cry of the female, after which it was evident that the two birds were together. A few minutes later the female flew back into the home-tree, but I did not see her on the nest when I had walked within view of it. In another five minutes or so, however, upon the renewal of the call of the male hawk, she flew, apparently, from off it—perhaps from a part of the rim where she was invisible or hardly to be seen in the still gloomy plantation. She could not, however, have been feeding the chicks, or I must have seen her. After this exit—no doubt the second one—there were the usual cries, and I saw the female fly from one tree to another, and, the last time, either into the home-tree itself or one whose branches adjoined it. From wherever she settled came the usual cry, which is uttered at intervals during a meal, discussed in this manner, for she has always fed silently on the nest. Very probably, therefore, she was feeding on what the male had brought her, but if so, she continued her meal upon the nest after she had flown to it again, at 4.30. At first she

ate, only, herself, nor did I see anything of the chicks, but, after a time, she began to give them a little, and they then became very conspicuous—like little white ghosts or hobgoblins—so that it would have been impossible to have missed them, had they been fed before—even more so than the grown bird were there degrees in impossibility. I could only see two, however, and begin to think that this may be the full number. The above tallies with a previous observation (June 24th) when the hen (from the first lightening) came twice to the nest and, each time, tore up and devoured something herself, but I could not make out that she fed the chicks before the third visit, with booty (remarkable as being brought by the male) at 8.25. Then, however, the chicks were younger, and might have done perhaps with more sleep and less early feeding.

It was not till after 6.30 that I again heard the cry of the male hawk (as I supposed) in the plantation—but very subdued. I was then away from the home-tree, but the female had kept on the nest up to a few minutes before this, and on returning to my post again—still hearing this very subdued weak note—I found the nest empty. I now walked into the open and saw one of the hawks flying, as before, over small trees and tree-bushes, into one of which he went down. When he rose from it again, a little later, he came flying swiftly down towards me, and, as he neared me, I saw that he carried something—a fragment, smaller I thought than on other occasions, but unmistakable. He flew into the plantation, whither I followed and saw either him again still flying with it, amongst the trees, or else the female who had received it from him. I thought, at the time, it was the female, and there had been ample time for the delivery, which, as has been seen, is a very quick affair. Walking to observe the nest, I found it still empty, but, in a moment or two, the female flew on to it and began to tear up and distribute to the chicks. I think now that the subdued cry which I heard in the plantation was not that of the male but of the female hawk who had left the nest, probably impatient for her partner's arrival. I had, indeed, received the impression of another hawk flying outside the plantation, besides the one I have mentioned. Of this, however, I could not be sure. There is no reason why the female, having thus left the nest,

should not have flown abroad, but had she caught her prey, she should have been at the nest with it before and not after the advent of the male. Moreover, the usual method must now, in all cases, be assumed where there is not sufficient evidence to prove its having been in abeyance. I now left.

Coming again at 4.15 p.m. I find the bird standing on the rim of the nest as though she had fed the young, not long since. Some time between 4.30 and 5 I heard the cry in the plantation, but I could only see one bird amongst the trees, and as the female had then left the nest, it may have been hers. This bird was still there when I went back to watch the nest at 4.55, and it was not till 5.25 that the female returned to it, but instead of feeding the chicks merely sat statuesquely on the rim. There was no importunacy on the part of the chicks. In this case there has been no good evidence of the presence of the male in the plantation—the facts point rather the other way—and accordingly the female, though she is some three quarters of an hour away brings nothing back with her. This, again, looks as though she were dependent on the male for her food supply—or, at least, as though the habit of awaiting him for it, were so confirmed as not to be easily broken through.

(To be continued.)

NOTES AND QUERIES.

MAMMALIA.

Variety of the Badger.—I have just seen, in my brother's possession, a variety of an adult male Badger, taken at Broxton, Cheshire. The black in the type is replaced by a rich fawn, and the grey is faintly tinged with the same colour. Eyes and irides dark pink; nails brownish black.—ALFRED NEWSTEAD (Chester).

Grey Seal (*Halichærus grypus*) in the Dee : a Correction.—On Feb. 20th last I examined a Seal (which was captured in the Dee at Chester on Nov. 19th, 1905), in the Grosvenor Museum, Chester. I was struck by its flat head, broad muzzle, dark pelage, and the comparatively wide space between its nostrils. Feeling sure that its label—Common Seal (*Phoca vitulina*)—was erroneous, I extracted some of its teeth, premolars and molars, and found that they had the simple crowns, and the premolars the connate roots of *Halichærus*. I compared these teeth with the description and plate in Owen's 'Odontography,' and with the grinders of a Common Seal and the Grey Seal which was captured at Warrington in 1908. I am satisfied that the animal has been incorrectly identified, and that it is a young Grey Seal. Unfortunately the error has been perpetuated in Forrest's 'Vertebrate Fauna of North Wales,' p. 42, and in the 'Vertebrate Fauna of Cheshire,' p. 42, for which Mr. Oldham and I are responsible. I wish to draw attention to this correction, which supports my belief that the Grey Seal, being probably resident, is of more frequent occurrence on the coast of North Wales, and consequently in Cheshire and Lancashire waters, than the Common Seal.—T. A. COWARD (Bowdon, Cheshire).

AVES.

Man Mobbed by a Ring-Ouzel (*Turdus torquatus*).—When crossing one of our local moors some time ago I could hear at a distance the scolding notes of a Ring-Ouzel, which increased in violence as I approached. Whilst still at a respectable distance, on my making a pause, the bird—a female—came and dashed at me with some vigour. Presuming it had a nest or fledged young, I started off in the direction where it was first seen. No sooner had I commenced my journey

than it precipitated and swooped in a most violent manner, disputing my passage at every step, and I was fearful at times lest it should hurl itself against my head, but this it did avoid, though at the least possible margin of actuality. I ascertained that the young had fledged, and noticed that the male bird kept at a safe distance. When this species has young it is usually noisy and even bold in its attack on any intruder into its haunts, but this I consider mildness itself in comparison with the fierceness and vehemence displayed in the above incident.—E. P. BUTTERFIELD (Wilsden, Bradford).

Are House-Martins Decreasing?—Of late years there has been no little controversy as to whether *Chelidon urbica* is decreasing, but from observations extending over a considerable number of years it would be difficult for us to predicate with certainty that such is the case. There is little doubt but that it can be affirmed to be less numerous in many of its old haunts than formerly, but, on the other hand, it is much more numerous—especially is such the case—in its more natural habitats. The Sparrow is one of its greatest enemies, and is undoubtedly responsible for its decrease in many localities. Some property here within the last two or three years has undergone considerable repairs, which has presumably decreased the nesting facilities of the House-Sparrow, and it is astonishing how the House-Martin has multiplied in the meantime. It may be that this species is returning to some extent to its more primitive breeding haunts, where it feels more secure.—E. P. BUTTERFIELD (Wilsden, Bradford).

Distribution of the Linnet.—I do not think it is possible that White made the mistake of confounding the Twite with the Linnet when he wrote that there were “in winter vast flocks of Common Linnets,” as suggested (*ante*, p. 69). Nor is it wonderful that the Twite is not mentioned in White’s letters, for it is extremely probable it never occurred at Selborne; even on the coast of Hampshire it is a rare bird (*‘Birds of Hampshire,’* p. 67), and I believe it is so everywhere inland in England, except in its northern breeding grounds. To the coast of England, as a winter visitor, it seems to be rare except in the eastern counties, where I have seen numbers in autumn and early winter. I have no authentic record of the occurrence of the Twite in Oxfordshire. With regard to the Linnet in winter, although it is true that it leaves Oxfordshire to some extent in winter, and that the great flocks we see in autumn usually leave us before winter, yet this is not always so. On Dec. 1st, 1903, I saw on a wheat-stubble the largest flock of Linnets I ever met with—it must have comprised several thousands. And on Jan. 22nd, 1904, I saw a

big flock in a clover-field on high ground. It is unlikely that these were very early returning migrants (for they commonly return in February and March), and it is noted in my journal for that day that Linnets had been numerous all the winter.—O. V. APLIN (Bloxham, Oxon).

Hen-Harrier (*Circus cyaneus*).—An immature female of this species was presented by Mr. Hugh Aldersey to the Chester Museum, by whom it was shot on the Aldersey Hall Estate, near Broxton, Cheshire; date doubtful. As this bird is now only a rare visitor to the county of Cheshire, I thought it advisable to send this record for publication. The donor told me that there is no mistake as to its being a Cheshire specimen, and shot on his estate, but unfortunately he had forgotten the date.—ALFRED NEWSTEAD (Chester).

Domestic Habits of the Sparrow-Hawk.—While reading Mr. Selous's interesting notes on Sparrow-Hawks, I was much surprised to see his suggestion (*ante*, p. 53) that a bird whose eggs had been taken about mid-May would have had time to deposit a second laying, and hatch them out by June 23rd. A little consideration would have shown that the boy's statement was almost certainly correct, and I can only suppose that Mr. Selous is unaware of the fact that the period of incubation in this species is very prolonged. Additional observations on this subject are much needed, but I believe that incubation always lasts more than four weeks, and in some cases apparently exceeds five weeks in duration. The time, too (mid-May), would be about the average date for a full clutch, while, if the eggs in question had been a second laying, they would probably not have been hatched out before the first week in August, or late in July at the earliest. In England, where four or five old nests may often be seen within a short distance of one another, it is well known that they are used as larders, and it is interesting to find that when old nests were not available, that of some other bird (in this case a Jay's) may be used for this purpose.—F. C. R. JOURDAIN (Clifton Vicarage, Ashburne, Derbyshire).

The Honey-Buzzard (*Pernis apivorus*).—The Honey-Buzzard has long been known to breed in England, but, except in Hampshire, the eggs or nestlings in the nest have been discovered only in a very few instances. I have only been able to find records of eggs or nestlings being found in Northumberland, Northamptonshire (nest of four eggs), Oxfordshire, and Herefordshire; but I have not yet looked up the Burnham Beeches record of breeding annually for more exact

particulars. The reputed Yorkshire eggs seem to rest on an item in a sale catalogue. There are also two old records, not exactly localized. Willughby's nestlings, found in a nest which had formerly been a Kite's, were perhaps found near his house in Warwickshire (a county in which the Honey-Buzzard has twice since tried to nest), but there is nothing to prove that this is so. The other case, I think, may be consigned to Shropshire with some show of reason. Pennant figured a bird, supposed to be a female, shot on a nest containing two eggs, "blotched over with two reds something darker than those of the Kestrel," a good description of the eggs of the Honey-Buzzard. Pennant says, in his article on this bird in the 'British Zoology,' merely that he was favoured with this specimen by Mr. Plymly; but I find in the preface to that work that Mr. Plymly is described as of Longnor, Shropshire, in the list of learned and ingenious friends from whom Pennant had received information; and, as country gentlemen in the eighteenth century did not go much from home, it is more than likely Mr. Plymly got the birds and eggs in question from his own neighbourhood.—O. V. APLIN (Bloxham, Oxon).

Decrease of the Corn-Crake, Wryneck, and Nuthatch.—The decrease of the Corn-Crake as a breeding species, alluded to by Mr. J. Steele Elliott (*ante*, p. 74), is, I fear, general in England. But the fact must not be overlooked that the numbers of this bird have fluctuated in years gone by, even in Ireland—a country always favoured by this bird. Thompson, in his 'Natural History of Ireland' (one of the best books on our birds ever written), says that in the north of Ireland the Land-Rail became very much scarcer about the same time as the Partridge, and continued so for fifteen years. They were never more scarce than in 1843, "but within the last very few summers they have, like that species, rapidly increased." This volume was published in 1850. At no time had Thompson heard Corn-Crakes more plentiful than in 1848, and they were equally abundant in 1849. Mr. Ussher, in 1900, wrote of it as common and widespread, but states that it varies considerably in numbers from season to season, and from one locality to another ('Birds of Ireland'). Sir Wm. Jardine stated that it had decreased in the south of Scotland when he wrote. Ten years previously, in the Vale of Annan, the bird was extremely common, but "during last summer (1841) only one or two pairs being heard within a stretch of several miles" ('British Birds,' vol. iii. p. 331). So that there is a remote chance of the Corn-Crake again becoming common as a breeding species in England. The chance is remote, I fear, for the scarcity

has now lasted for a very long time. My notes on the former and present status of the Corn-Crake in Oxfordshire will be found in 'The Zoologist' for 1903, p. 451, and I do not think the state of affairs has altered much or at all since then. We hear of one sometimes, but may go through a summer without hearing the bird's delightful craking. It is probably less rare in the wide meadows bordering the upper Isis than elsewhere in the county. Last summer, however, I had a treat. A Corn-Crake established itself in a clover-field on the east side of this village, where one had not been heard for years, and I enjoyed the rare pleasure (formerly a common one) of hearing the Corn-Crake's call at night from the house. I had not done so since 1904. The bird was seen when the clover was cut in the second week in July, but no nest was found, although I offered a reward for a report of it if discovered. We still get passing migrants in autumn, and if there are any standing crops in the first half of September a fair number of them get shot. This year I shot two on the 3rd, and another was killed in standing barley and not recovered. I saw another shot on the 10th. There were such great breadths of barley and beans standing on the 3rd, and these were beaten so loosely, that it is a wonder any Land-Rails were flushed. I wonder what the proportion of birds was that were *not* put up, for the Land-Rail is a hard bird to flush from heavy cover. I saw one bird in September which had pitched in a bit of barley, too badly "laid" for the machine to cut it, run out of this, and make its way in a crouching attitude over the rest of the field, hiding under one of the barley-sheaves, which lay on the ground, from time to time. This is only the second time, as far as I remember, that I have seen a live Corn-Crake on the ground in autumn.

There is evidence that the Wryneck was common in Oxfordshire at one time, and it was certainly well enough known to be called by its common name of "Cuckoo's Mate," as well as by another local name. But it has been almost a rare bird for many years, and we do not look for its regular arrival in spring. In 1903—a very wet year—it looked as if the Wryneck was coming back to us. There was a bird on the outskirts of the village during the first week in May, and on the 9th I made a note of the fact that we had three, if not four, about. I left home for a month three days later, and I never saw or heard any more of them. The next year I heard one and saw a pair at the end of April. Since that date I have only noticed occasional birds. The Nuthatch is another bird which has decreased greatly of late years. It used to be quite common here, and its sweet whistling notes were a familiar sound in the early part of the year. It is not

quite extinct, for we have had a pair coming to the drawing-room window-sill for nuts for some weeks recently (February, 1911). The only cause for their decrease that I can think of is the great increase in Starlings, which came to a head a few years ago, and has, I am glad to say, abated a little lately.—O. V. APLIN (Bloxham, Oxon).

Decrease of Corn-Crake and Wryneck.—Mr. Steele Elliott is, I believe, quite right as regards the decrease in the numbers of the Corn-Crake. I can corroborate his statement, so far as this county is concerned, that thirty years ago a pair at least of Corn-Crakes were to be found nesting in almost every large meadow. Last summer I thought I heard the familiar "crake, crake" rather more frequently than in 1909, and the delay in the hay-harvest about here, owing to wet weather, I hope may have saved some nests. I put down the serious diminution of the species principally to two causes:—(1) the destruction of the birds and their nests by mowing-machines, and (2) Corn-Crakes being killed by flying against telegraph- and telephone-wires. The destruction of bird-life from the second cause I have mentioned is sadly increasing, owing to the increase in the number of these wires. On many, if not most, railways these wires are now erected on *both* sides of the lines, and often, being at different heights, form a network of wires eight to ten feet deep, which it is impossible for wild birds to avoid on foggy nights. Platelayers find dozens of birds killed from this cause on their morning patrol of the railways. The time has now come, in my opinion, when the Corn-Crake and its eggs should be absolutely protected for, say, a term of five years at least, in the hope of saving this useful bird from its threatened extermination. Only on Saturday last (Feb. 17th) a postman not far from here put up a Partridge, which, swerving from its direct flight, came in contact with telegraph-wires, and fell dead.

I cannot speak as to the present status of the Wryneck generally, but it is now an extremely rare bird in this county. The last occurrence of the species that I have heard of in North Staffordshire was one picked up at Ellastone on Sept. 26th, 1909, injured through flying against wires. As this is a purely insectivorous species, it should also, I think, be absolutely protected, as well as its nest and eggs. In our new Staffordshire Wild Birds Protection Order, which extends protection to all our rarer and most useful birds, is included a close-season for the Woodcock after Feb. 1st, and it makes it illegal to take Plover's eggs after April 7th in any year. — JOHN R. B. MASEFIELD (Rosehill, Cheadle, Staffordshire).

"Decrease of the Corn-Crake and Wryneck."—Referring to Mr. Steele Elliott's remarks under this heading (*ante*, p. 74), very much the same state of things prevails in South-west Surrey.

Corn-Crake.—During the last seven or eight years I have personally only had three records of this bird :—(1) A nest in the village of Hambledon about the year 1901 ; from this I have an egg in my possession. (2) Three specimens were caught alive, but injured by telegraph-wires, by a man working on the line at Guildford in July, 1902. I have one of these birds in my collection. (3) A nest in the neighbourhood of Dorking in 1907. As to the probable cause of the scarcity of the Corn-Crake, I can offer no definite reason, but would suggest a succession of unseasonable summers, and possibly the new reaping-machines killing the birds, old and young, from their skulking habits. Also the reclaiming of old haunts for building purposes. It is many years now since I have heard the familiar cry. Bucknill ('Birds of Surrey'), writing in 1900, says :—"In some years it is very much more common than in others, but over the whole of the rural district of the county is generally freely distributed."

Wryneck.—It is worth noting that, although abundant in the parishes of Milford and Witley, the Wryneck is entirely absent from Brook (which joins Witley parish), and for the past four years I have listened in vain for its note. This is all the more extraordinary, because the bird is so plentiful not only in the parishes named but throughout the whole south-western portion of Surrey. I can offer no explanation, for the country in Brook is so well wooded, and differs in no way from neighbouring villages, being, if possible, even more rural.—GORDON DALGLIESH (Midhurst, Sussex).

Immature Glaucous Gull (*Larus glaucus*).—A specimen was shot on the shore at Deganwy on Thursday, Feb. 23rd, 1911, and presented to the Chester Museum by Dr. A. Hamilton. The stomach contained a few shore-pebbles only. Sex undeterminable. The donor writes :—"Since I first saw it, it has always more or less been amongst the large flock of Herring and other Gulls which frequent the beach in front of my house, and feed largely on the garbage deposited there."—ALFRED NEWSTEAD (Chester).

MOLLUSCA.

A Large Squid on the Northumberland Coast.—A fine example of the large species of Squid (*Sthenoteuthis pteropus*, Verr.) was cast ashore recently on the coast of Northumberland. It was found on Jan. 8th, 1911, by Mr. H. V. Charlton, on the sandy beach between

Whitley Bay and St. Mary's Island, about three miles north of the mouth of the Tyne. Though dead it was quite fresh, and the only damage it had suffered was the loss of one eye. Mr. Charlton has presented it to the Hancock Museum, Newcastle-on-Tyne, where it is now preserved. It is unnecessary to give many particulars of this specimen, as a good description of the species has been published already (Goodrich, Journ. Marine Biol. Assoc. 1892, vol. 2, n. s. p. 314). There appear to be only about half a dozen records of its occurrence on the coasts of Britain, and apparently in only two instances has the animal been preserved. The last record that I know of is that of an example thrown up at Redcar in December, 1907, described and figured in the 'Naturalist' for April, 1908 (Hoyle, "A Large Squid at Redcar"). Our example is of about the average size. Its total length is 5 ft. 6½ in.; from mouth to hinder extremity of body, 2 ft. 9½ in.; length of tentacles, 3 ft.—E. LEONARD GILL (Hancock Museum, Newcastle-on-Tyne).

OBITUARY.

ROLAND MAURICE DIXON, B.A.

THE story of a simple, straightforward life (born Nov. 22nd, 1858; died Nov. 26th, 1910) is soon told. Mr. Dixon received his early education in Bombay, and graduated as B.A. from the University there in the year 1880, taking Botany and Zoology as his optional subjects. In the year 1884 he joined the Government Service in the Educational Department as an Assistant at the Victoria and Albert Museum, Bombay. The next year his services were placed at the disposal of the Government of India, and he was attached to the Indian Museum, Calcutta, to assist Dr. Watt in preparing a collection of raw products in connection with the London and Bombay Exhibitions. On his return to Bombay he was appointed Assistant Curator of the Victoria and Albert Museum. The following year the Museum was transferred to the Bombay Municipality, and in 1894 he was appointed to act as Curator of the Museum, and at the same time acted as Professor of Biology at the Elphinstone College, Bombay. In 1902 he was appointed *sub pro temp.* Curator of the Museum. In 1905 his services were replaced at the disposal of Government in the Revenue Department, and Mr. Dixon was transferred to Poona as Assistant Entomologist to Government. With the inauguration of the New Agricultural College scheme he was gazetted Professor of Entomology, and gave lectures in Zoology in addition to his own duties. He was the first Examiner in Entomology for the B. Agr. Degree to the University of Bombay. These appointments he held till his death at Khandala.

Mr. Dixon was a man of letters, but essentially a man of science. He was an authority on the flora and fauna of Western India. He published several original papers on the less known plants of the Bombay Presidency. But entomology was his special subject. In his earnest desire to advance the cause of science he toured all over India, both officially and unofficially, very often at great personal inconvenience. He assisted Mr. W. L. Distant with considerable material in preparing his volumes on Rhynchota in the 'Fauna of British India Series,' and also took a special interest in snakes, and made important contributions to the knowledge of their life-history.

Mr. Dixon was a man of a very kind and gentle nature and genial temperament. He was loved and admired by all who had anything to do with him. His sanctum was at all times open to any student who honestly desired information, while he took almost a paternal interest in his students.

Mr. Dixon was a member of several scientific and learned societies, both in Europe and in India. At congresses of zoologists or entomologists or botanists in India, Mr. Dixon would be asked to contribute a paper, and he nearly always had some original subject to bring forward. *Actis ævum implet non segnibus annis* was Mr. Dixon's motto, and his life was its concrete example.

JAMES DIXON.

NOTICES OF NEW BOOKS.

Convergence in Evolution. By ARTHUR WILLEY, D.Sc., F.R.S., &c.
John Murray.

THIS is an important contribution to evolutionary literature, and is an example of the Darwinian method applied to the further development of Darwinian philosophy. Convergence in evolution is no new term, but it represented more or less an idea; Dr. Willey has endeavoured in this small volume to make it a reality. His thesis is "that convergence is neither identical with homoplasy* nor with cenogenesis,† but that it includes these and something else besides. All homoplasy is convergence, but all convergence is not homoplasy; and the same dictum may be repeated, *mutatis mutandis*, for cenogenesis."

* "Homoplasy," a term proposed by Sir Ray Lankester to signify similarity of form unaccompanied by community of pedigree.

† "Cenogenesis" implies the origin of structural features by relatively recent adaptation, in contrast with "palingenesis," or primordial adaptation; both terms proposed by Prof. Haeckel.

The above quotation, with its formidable though necessary terminology, may unintentionally give an impression that this publication is of a more or less scholastic nature, an inference to be repudiated once for all, as it abounds with interesting observations, many of which are quite original. The field naturalist frequently finds an occurrence of which he is quite familiar used as a philosophical conclusion by another observer in a way that never appealed to his cognition. Thus, Dr. Willey, observing in Ceylon the flights of Crows and Flying-foxes, describes these as instances of "convergent homing," the same trees affording hospitality in regular alternation to day-flying birds and night-flying mammals. Another conclusion, well stated, is that "the basic quality underlying all animal life is the cryptic, the fear of the sun. Basking in the sun is a dangerous pastime." The chapter on "Mimicry and Homoplasy" is fair and candid to both cautious adherents of the usual explanation of mimicry and to its advanced apostles. *"We may safely claim that the possession by noxious animals of common warning coloration is as much due to convergence as is the possession by harmless animals of a common protective coloration; and both these colour-schemes are referable to conceivable though indefinite reactions. On the other hand, the resemblances and associations between palatable and unpalatable insects are hard to explain on the tropism* theory, unless we suppose that they arose by ordinary convergence before advantage was taken of them by natural selection."*

It is, however, impossible to do justice to Dr. Willey's enunciation of 'Convergence in Evolution' in a short notice like the present one. A great number of facts and arguments are adduced that can scarcely be appraised at their proper value except by the few; specialists will, on the contrary, be more at home with the arguments which apply to their own studies. This volume is again evidence that students of organic evolution are ceasing to believe that there is only one path through the wood.

* "Tropism means the tendency to react in a definite manner towards external stimuli."

